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and point, perhaps, to the original food-plant of the San José scale.

T. D. A. COCKERELL.

NOTES ON PHYSICS.

ARCHITECTURAL ACOUSTICS.

ABOUT five years ago Professor W. C. Sabine was directed by the Corporation of Harvard University to propose means for remedying the acoustical defects of the lecture room of the Fogg Art Museum at Cambridge. About two years were spent in experimenting on this room and permanent changes were then made.

The experimental work done in connection with this lecture room has led Professor Sabine to take up seriously the general question of architectural acoustics and we are promised a series of papers on this subject the first of which, on reverberation, is published in a recent number of the *American Architect*.

In an introductory chapter Professor Sabine gives a clear and comprehensive statement as to the different ways in which sound is affected by being confined in an audience room, substantially as follows:

The *loudness* of the sound is as a rule greater at a given distance from the speaker than it is in the open air.

The *character* or *timbre* of a complex sound is more or less altered by re-enforcement of certain of its elementary tones by resonance, or by the re-enforcement or weakening of some of its elementary tones at certain parts of the room by interference. This alteration of the character or timbre of a complex sound Professor Sabine calls *ditortions*.

The sound *persists* in a room for a considerable time after the sounding body ceases to vibrate. This is due to the more or less complete reflection and re-reflection of the sound from the walls, floor and ceiling. This persistence of sound in a room Professor Sabine calls *reverberation*. It causes the successive sounds in articulate speech to overlap and become confused. Especially the sonorous vowel sounds persist, and obscure the delicate and fleeting variety of the consonant sounds.

The question of loudness becomes a serious matter only in very large audience rooms.

Sound distortion and reverberation depend

very largely upon the same conditions. Thus the extent to which an air column will enforce the tone of a tuning fork depends largely upon the length of time the air column will continue to vibrate when left to itself after having been set vibrating. Sound distortion is not so serious a matter as reverberation and, since the two depend largely upon the same conditions, it seems that reverberation only need be considered in any practical case.

The reverberation of a room, measured by the duration of a sound after the sounding body ceases to vibrate, depends upon the absorbing power of the walls and of other reflecting surfaces and upon the size of the room. Thus heavily draped walls or walls lined with thick felt absorb much and reflect little of the sound which strikes them, and a sound persists but a short time in a room of which a considerable portion of walls are padded or draped. An audience also absorbs a large portion of a sound in a room and greatly reduces reverberation. A larger room has greater reverberation than a small room, walls being of similar material, because the sound has farther to travel between succeeding reflections, and a greater time is therefore required for the absorption of a given portion of the sound.

Professor Sabine found that the note of a particular organ pipe remained distinctly audible in the lecture-room of the Fogg Art Museum for 5.6 seconds after the blowing of the pipe ceased. The method proposed and carried out for the reduction of reverberation was to line a considerable portion of the walls of the room with a thick hair felt.

Professor Sabine has determined, by a very ingenious method, the absorbing power of a variety of wall surfaces, such as brick, plaster on brick, plaster on lath, glass and boards, and he has shown that the reverberation of a room can be pre-determined by calculation in terms of the size of the room and the character of its walls.

W. S. F.

NOTES ON INORGANIC CHEMISTRY.

A very considerable amount of work is being done at the present time in filling up the many gaps that exist in descriptive inorganic chem-